SOME ASPECTS OF THE COAL INDUSTRY OF THE U. S. S. R.

BY GEORGE MARKON AND GEORGE D. DRECHSLER

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SOME ASPECTS OF THE COAL INDUSTRY OF THE U.S.S.R.[1]

by

George Markon[2] and George D. Drechsler[3]

SUMMARY

The rapid growth and development of the Soviet coal industry rank the U. S. S. R. with the United States among the leading coal-producing countries. The coal resources of the Soviet Union are among the largest in the world, although coal development has been hindered by the disadvantageous location of the coal deposits with respect to the major consuming centers.

Although coal production in the U. S. S. R. reached a record high, the total energy output of mineral fuels in 1957 was still far below that of the United States because a significant part of Soviet coal output was lignites or lower rank coals. Although the Soviet coal industry soon may exceed that of the United States in tons produced, the energy equivalent of Soviet output will be considerably less because of the inclusion of a high percentage of lower rank coals. Energy sources in the United States also involve large quantities of oil and natural gas, whereas coal supplies most primary energy in the Soviet Union.

The rapid rise in Soviet coal production has not been matched by gains in productivity; however, mine capacities, surface mining, and coal-preparation facilities are being expanded at a rapid rate. Since World War II the U. S. S. R. has become a net-coal-exporting country.

For utmost consistency with the source data used for this report, most figures are shown in metric measures; the conversion factors are: 1 metric ton = 1.10231 net tons (2,000 lb.) for weight measure and 28 cubic meters = 1,000 cubic feet for volume measure. The standard coal equivalent was computed on the basis of reported heating values of specific fuels and on variations in the types and qualities.

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Salient statistics, in standard United States measures, are as follows:

	United States	U. S. S. R.
1956		
Total coal production, net tons	528,889,000	473,111,452
Coal equivalent	526,922,533	375,730,922
1957		
Total coal production, net tons	514,695,000	510,369,530
Coal equivalent	512,929,596	405,524,317

INTRODUCTION

In recent months interest has been renewed in Soviet Union coal industry; it has emerged into a dominant world position and, according to preliminary information, will produce a greater tonnage of coal than the United States in 1958. Previously, few people had access to knowledge of developments in the Soviet coal industry, and relatively little published information found its way to Western readers; however, more information and statistical data have been published recently.

The purpose of the following comments on a few aspects of the Soviet coal industry is to provide information on most questions received by the Federal Bureau of Mines and to explain that, while Soviet coal production may be greater than that of the United States in tonnage, it is considerably less in energy equivalent. Also, whereas the Soviet economy depends on coal for most of its energy supplies, energy in the United States is derived from large quantities of oil and natural gas, besides coal.

The material for these notes came chiefly from official Soviet publications. Where possible, an attempt was made to correlate the information with similar data on the United States coal industry, which was taken almost exclusively from Federal Bureau of Mines Mineral Market Summary 2715, Bituminous Coal and Lignite in 1956, to make it understood more readily.

No attempts was made to present a detailed analysis and review of the entire Soviet coal industry. The subject is too broad for more than a limited review at this time.

Because the average reader in the United States in unfamiliar with Soviet designations of all but the most widely known coal basins, a map (fig. 1) and a brief review in translation of the Soviet coal industry taken from Ekonomika Organizatsiya Proizvodstva i Planirovaniye V Ugol'noi Promyshlenosti SSSR (The Economics, Organization of Production, and Planning in the Coal Industry of the U. S. S. R. by G. F. Mikheyev - a textbook used for study at Mining Technicums and published by Ugletekhizdat (Coal Technical Publishers) in Moscow in 1957) are appended to the report.

The Soviet coal industry is undergoing a period of rapid growth and expansion. The U. S. S. R. has risen from fourth place in world coal production in 1937 to rank second to the United States in 1957 in total output of all types of coal. Although the United States coal industry's share of the growing demand has been diminished by strong competition (particularly from oil and natural gas), the Soviet coal industry, favored by a period of rapid national industrialization, is the predominent supplier of energy to the U. S. S. R. economy. The expanding energy market and industrial growth of the Soviet Union give its coal industry assurance of continued growth far beyond its present levels. Although Soviet coal-production figures are impressive, their significance is lessened because they include large tonnages of lower quality coals that average only half of the energy value of an equal weight of standard bituminous coal.

STRUCTURE OF MINERAL-FUELS PRODUCTION

The comparative significance of the respective fuels in total mineral-fuels production of the United States and the U. S. S. R. is shown in table 1.

In 1937 coal represented 56.3 percent of the United States mineral-fuels production, compared with 67.1 percent in the U. S. S. R. In contrast, as a result of increasing oil and gas supplies, the position of coal in the United States mineral-fuels output dropped to 34.5 percent by 1955, while in the Soviet Union coal rose to 70.4 percent of the total production. During this period there was a rise in the contribution of natural gas to the total energy supply of both nations. In the United States natural gas increased sharply from 11.6 percent of the total mineral-fuels production in 1937 to 38.3 percent in 1955, and in the U. S. S. R. it rose from 1.6 percent to 2.2 percent. Because the Soviet coal deposits are not near the consuming areas, peat and combustible shales are used as fuels. In 1955 peat and shales furnished nearly 5 percent of the mineral-fuels output. The use of these fuels in the United States is not significant. The total mineral-fuels production in the United States and in the Soviet Union are compared in table 2.

TABLE 1. - Structure of mineral-fuels production, the U. S. S. R. and the United States, selected years

(Percent of production, standard bituminous-coal equivalent)

	1937		1940	
	U. S. S. R.	United States	U. S. S. R.	United States
Coal	67.1	56.3	70.1	55.3
Petroleum	25.0	32.1	21.7	32.4
Natural gas	1.6	11.6	1.9	12.3
Peat	6.2	(1/)	6.0	(1/)
Combustible shales	.1	(1/)	.3	(1/)
	100.0	100.0	100.0	100.0
	1950		1955	
	U. S. S. R.	United States	U. S. S. R.	United States
Coal	73.2	44.5	70.4	34.5
Petroleum	18.9	34.7	22.5	38.3
Natural gas	2.2	20.8	2.2	27.2
Peat	5.0	(1/)	4.2	(1/)
Combustible shales	.7	(1/)	.7	(1/)
	100.0	100.0	100.0	100.0

1/ Negligible.

NOTE: United States figures exclude negligible amounts of shale and peat used as fuel. Soviet figures represent mines under Ministry of the Coal Industry.

TABLE 2. - Production of mineral fuels[1], the U. S. S. R. and the United States, 1937, 1950-57

	1937	1950	1951	1952	1953	1954	1955	1956	1957
U. S. S. R.									
Coal[2] .... million metric tons	128.0	261.1	281.9	300.9	320.4	347.1	391.3	429.2	463.0
Peat .... Do.	24.0	36.0	39.8	37.2	38.6	45.0	50.8	44.3	54.0
Petroleum .. Do.	28.5	37.9	42.3	47.3	52.8	59.3	70.8	83.8	98.0
Gas[3] .... billion m^3	2.3	6.2	6.8	7.4	8.0	8.8	10.4	13.7	20.2
United States									
Coal[2] .... million metric tons	451.2	508.8	522.8	460.3	442.9	382.0	445.3	479.8	470.1
Peat as fuel[4]... Do. ..	-	-	-	-	-	-	-	-	-
Petroleum .... Do. ..	172.9	266.7	303.8	309.4	318.5	312.8	335.8	353.7	352.0
Natural gas ..billion m^3	70.0	177.9	211.2	226.9	237.8	247.6	263.9	271.2	299.3

1/ Excludes oil shale.

2/ Includes anthracite and lignite.

3/ Includes manufactured gas; for 1955 and 1956 natural-gas output in the Soviet Union was 9 by 10^9 and 12.1 by 10^9 cubic meters, respectively.

4/ Negligible.

Production

The spectacular gains in Soviet coal production in terms of physical units or tonnage cannot be denied, but much of the production is comprised of lower quality bituminous coal and lignite. Approximately 29 percent of the total coal production of the U. S. S. R. in recent years has been lignite; the remainder comprised about 15 percent anthracite and 56 percent bituminous coal of varying qualities and grades. In contrast, United States coal production is comprised of about 94 percent bituminous coal, 5 percent anthracite, and less than 1 percent lignite. Lower rank coals in the United States are generally not competitive and have disappeared from the market, except under certain unusual local conditions. Thus, comparing the coal production of the two countries in terms of physical units and approximate standard bituminous-coal equivalents for 1956 and 1957 reveals considerable differences, as shown below:

Total coal production, the U. S. S. R. and the United States, 1956-57

(Thousand metric tons)

	1956		1957	
	Production	Coal equivalent	Production	Coal equivalent
United States	479,808	478,024	470,066	468,458
U. S. S. R.	429,200	340,861	463,000	367,888

Because so little lignite and lower quality coal is mined in the United States, the production figures (in terms of physical units and tons of standard coal equivalent) show no significant differences; however, in the U. S. S. R. the difference between the tonnage produced and its value in standard coal equivalent in 1957 was nearly 100 million tons - about 21 percent. Although the coal equivalent for the U. S. S. R. in the above figures was drawn from estimates and computed on the basis of the European standard (7,000 kilocalories per kilogram as compared with an American standard of 7,278 kilocalories per kilogram or 13,100 B.t.u. per pound) for convenience, the United States coal equivalent was made roughly equal to the Soviet standard equivalent.

An index for comparing coal production in the two nations is the coal production per capita in terms of weight and standard coal equivalent as well as the total energy production per capita in terms of standard coal. Representative estimates per capita on coal production in 1957 and their equivalent in standard coal are shown in the following table:

Estimates of coal production per capita for selected countries, 1957

	Coal production (thousand metric tons)	Per capita production (metric tons)	Standard coal equivalent (metric tons)
United States	470,060	2.745	2.736
U. S. S. R.	463,000	2.292	1.821
Federal Republic of Germany ...	1/133,202	1/2.588	1/2.588
United Kingdom	227,216	2/4.437	4.437
Poland	94,000	3.357	3.357

1/ Excludes brown coal.
2/ Relates to 1956 population.

It is interesting to note that the U. S. S. R. in 1957 produced 2 percent less than the United States tonnage. In per capita production (actual), however, the Soviet Union fell to about 83.5 percent of the United States figure, while on a standard-coal-equivalent basis the U. S. S. R. dropped to approximately two-thirds of the United States figure. This comparison favors the U. S. S. R., where about 70 percent of the energy is obtained from coal; however, it excludes any reference to other major energy sources, which comprised about two-thirds of the total energy balance in the United States. The imbalance of the comparison becomes more apparent when other coal-based economies are included. In the United Kingdom production per capita ranks highest, with nearly twice the United States and U. S. S. R. levels but only 24.5 percent above Poland. In West Germany per capita production would rank second to the United Kingdom if, as in the U. S. S. R., brown coal was also included.

On a standard-coal-equivalent basis the per capita production of mineral fuels in the U. S. S. R. in 1957, excluding combustible shales, is estimated at about 2.690 metric tons; in the United States, using the same factors for conversion, per capita energy production was 7.892 metric tons in standard coal equivalent for the same year. Thus, if in 1957 the U. S. S. R. had produced twice its coal, petroleum, peat, and natural-gas output, its energy production per capita would have been roughly two-thirds of that of the United States. Even with the achievement of the goals set for 1960 under the Sixth Five-Year Plan, the Soviet Union will fall considerably short of the United States total energy production.

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On the basis of coal output in physical units, as distinguished from the energy values of the tonnage, the Soviet Union will undoubtedly overtake the United States in 1958. The record growth of the Soviet coal industry - never less than a 6.5 percent annual-production increase since 1946 - indicates that coal output will exceed 500 million metric tons during 1958 and may reach the planned figure of 593 million metric tons in 1960. In the United States, on the other hand, no such spectacular gains in coal production are expected in the near future; the problem is not one of reserves or the capacity to produce but rather a loss of markets to competitive sources of energy. If the coal demand were increased significantly, there would be no problem in increasing coal production in a relatively short time; however, great changes in adding new capacity in cases of dire emergency cannot be accomplished without a considerable expenditure of time and investment. In contrast the U. S. S. R. coal industry has had an unsatiated demand over the years, and industrialization, with its ever-increasing energy demand, has led the rapid growth of the coal industry.

The coal industry of the U. S. S. R. is centered in the European section, as are most of the large coal-consuming industries. As much as 87 percent of the total coal production in earlier years came from the Donets Basin. The only other source of coal at that time was the Sub-Moscow Basin, which produces a low-grade, high-ash, brown coal. New coal discoveries in the east in recent decades have redistributed and changed the structure of Soviet coal production. Although the Donets Basin is still the largest single coal-producing area in the U. S. S. R., its share of the total output has been reduced from 60 percent in 1937 to about 36 percent in 1955. The Donets Basin mines will continue to supply a large part of the country's coal requirements because they are located in the industrial consuming areas and because they yield a higher quality coal, despite higher costs and generally less favorable mining conditions. More than 60 percent of Soviet metallurgical coke is produced from Donets coals, and new reserves discovered in geological research have assured the basin continued growth and development.

The quality problem will continue to plague the Soviet Union, although the coal industry is being redistributed in the west as well as the east. Coals from many of the new mining areas of the European part of the U. S. S. R. cannot be substituted for Donets coking coals, and the only other major sources of high-quality coking coals are the Kuznetsk and Karaganda Basins and, to a lesser extent, the Pechora Basin - all more than a thousand miles from the Donets-based industry. New industrial complexes of the eastern regions will also require more higher grade coking coals.

Mining conditions in the Soviet Union are generally good as compared with European mines, although at most mines prevailing conditions are far less favorable than in the United States. A large part of the Soviet coal production comes from mines where gas and dust present hazards. Much of the coal produced is of inferior grade by United States standards. In the largest coal-producing and coal-consuming area (Donets Basin) the prevailing mining conditions are among the poorest; thin seams, high gas seepage, and dust problems result in higher production costs.

The coal seams lie at a relatively shallow depth as compared with other continental European coal mines, and productivity is generally higher. Most of the shallow-depth seams suitable for strip mining, however, are in the eastern regions, which supply about 90 percent of the Soviet Union total strip-mined output.

Mechanization and mining methods are constantly being improved, and the immense coal reserves of the U. S. S. R. compensate somewhat for the natural limitations of some of its coalfields. Soviet organization, planning, and research in the coal industry have shown an acute awareness of the industry's needs, and policy appears to be directed toward fulfilling those needs within the framework of the greater national economic plans.

Size and Number of Mines

Besides increasing coal production, the average size of the Soviet mines also have grown. The average daily output per mine rose from 738 metric tons in 1940 to 929 in 1956. The number of operating Soviet coal mines, classified by their average daily output for 1940, 1950, and 1956, is given below (1):[4]

	1940	1950	1956
Total number of mines[1]	553	924	1,047
Number of underground mines	546	897	1,002
Average daily output, metric tons:			
2,001 or more	42	41	102
1,001 to 2,000	104	146	256
501 to 1,000	167	279	309
301 to 500	114	171	159
101 to 300	97	193	141
100 or less	22	67	35
Number of strip mines	7	27	45
Average daily output, metric tons:			
5,001 or more	-	2	14
3,001 to 5,000	2	7	14
1,001 to 3,000	5	14	16
1,000 or less	-	4	1

[1] Excludes mines outside the former Ministry of the Coal Industry.

Using some of the above data and assuming a 300-working-day year, some approximation of how Soviet mines compare with those of the United States can be seen from the following data:

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[4] Underlined numbers in parentheses refer to items in the bibliography at the end of this report.

U. S. S. R.1/		United States	
Average annual output, metric tons	Number of mines	Average annual output, metric tons	Number of mines
600,000 or more	42	450,000 or more (Class I)	246
300,000 to 600,000	104	180,000 to 450,000 (Class II)..	323
150,000 to 300,000	167	91,000 to 180,000 (Class III)..	365
90,000 to 150,000	114	45,000 to 91,000 (Class IV) ...	488
30,000 to 90,000	97	9,000 to 45,000 (Class V)	2,112
30,000 or less	22	45,000 or less (Class VI)	4,986

1/ Excludes surface mines; the number and approximate average annual capacity in 1956 were:

Capacity	Number
1,500,000 metric tons or more	14
900,000 to 1,500,000	14
300,000 to 900,000	16
300,000 or less	1

NOTE: United States data exclude anthracite; all data are converted to metric tons and rounded. Data for U. S. S. R. capacities are approximate at 300 working days annually.

Although the data are not directly comparable, some interesting features of the Soviet coal-mining industry are disclosed. In 1956 the U. S. S. R. reported 1,002 underground and 45 surface mines; the United States had 6,542 underground and 1,728 surface (strip) mines, and 250 auger mines. Although 58.5 percent of the United States mines are in the smallest category and supplied only 4.3 percent of the total bituminous-coal production, the U. S. S. R. mines in a similar category produced 3.5 percent and can be assumed from the data available to share less than 1 percent of the production. In the United States 2.9 percent of the mines in 1956 were Class I mines (500,000 tons or more annual output) and produced 48.6 percent of the total bituminous-coal output.

Surface Mining

The Soviet emphasis on ever-increasing coal production has led to extension of surface (strip) mining, because this method offers lower costs, higher productivity, and more rapid production development. Surface mining development was impeded in the Soviet Union in earlier years when coal production was centered in the west, where the coals generally are at considerable depth. The planned development and rapid progress in surface mining already achieved relates to the eastern regions of the U. S. S. R. almost exclusively.

In the United States the higher productivity, lower investment, and production costs of surface mining have also extended the use of this type of mining, although the peak output was reached in 1948. Since 1950 bituminous-coal surface-mining tonnage has varied between 122,550,693 and 93,071,738 metric tons. In 1957 United States surface-mined bituminous coal tonnage reached 119,748,420 metric tons. A comparison of the proportion of surface and underground mining in the United States and the U. S. S. R. is shown in the following production data (1, 2):

(Thousand metric tons)

Year	United States 1/				U. S. S. R. 2/		
	Underground	Auger	Strip	Total	Underground	Surface	Total
1940	378,845	-	39,160	418,005	146,900	6,300	153,200
1950	356,382	-	112,007	468,390	221,700	27,100	248,800
1951	377,432	-	106,701	484,123	239,100	30,100	269,200
1952	323,343	1,366	98,802	423,511	253,100	34,900	288,000
1953	317,107	2,078	95,661	414,847	264,000	42,300	306,900
1954	262,278	4,046	89,026	355,350	281,100	52,200	333,500
1955	311,586	5,511	104,411	421,508	311,600	64,900	376,500
1956	331,825	7,298	115,252	454,385	351,700	77,500	429,200
1957	324,772	9,072	110,677	444,521	N.a.	N.a.	463,000

1/ Excludes anthracite.
2/ Figures for mines under the Ministry of the Coal Industry, 1940, 1950-55.
N.a. Not available.

In 1940 about 4.3 percent of Soviet coal production was surfaced-mined. In 1956 surface mining furnished 18 percent of the total coal output. Surface mining supplied 71.2 million tons (25.8 percent) of the 276-million-metric-ton increase in coal production in the U. S. S. R. between 1940 and 1956. In the United States surface mining furnished 9.3 percent of the total coal production (excluding anthracite) in 1940 and nearly 27 percent in 1956. Surface mining has shown no great variations in total bituminous-coal production in the United States in recent years, while in the U. S. S. R. surfaced-mined tonnage showed an average annual increase of about 19 percent since 1950. At such a rate of growth the U. S. S. R. surface-mined-coal production will reach or exceed the 1957 surface output of the United States by the end of 1960.

Auger mining, which was not reported separately until 1952, rose from 1,366,221 metric tons during that year to 9,071,850 tons in 1957. No auger mining is reported in Soviet statistics.

Worker productivity

One of the areas of intensive study and application in the Soviet coal-mining industry has been worker productivity. Through considerable mechanization and more efficient work organization, worker productivity in Soviet coal mines has increased to a level comparable to the highest of the European countries. The Soviet Union, however, falls far short of the high level of productivity achieved by the United States bituminous-coal industry. Although the reported statistics, are not directly comparable, they represent a reliable index of the comparative growth and general level of productivity in the respective coal industries. Below is a compilation showing worker-productivity trends in the coal industries of the United States and the U. S. S. R.; data are in metric tons per man-day (2):

	1940		1945	
	United States	U. S. S. R.	United States	U. S. S. R.
Underground mines...	4.41	1.29	4.57	0.87
Strip mines.........	14.18	2.89	14.03	3.56
Average, all mines..	4.71	1.32	5.24	.97

	1950		1955	
	United States	U. S. S. R.	United States1/	U. S. S. R.
Underground mines...	5.22	1.20	7.51	1.43
Strip mines.........	14.21	4.18	19.16	7.63
Average, all mines..	6.14	1.30	9.33	1.67

1/ Excludes auger-mining productivity: 22.22 net tons or 20.16 metric tons per man-day in 1955.

NOTE: United States data exclude anthracite and lignite mines; U. S. S. R. data for mines under Ministry of Coal Industry only. Productivity figures are not absolutely comparable; however, they indicate the trends and the general level of achievement in the respective industries.

The data in the table show that United States productivity in 1955 was over 5 times higher in underground work, 5.5 times higher for the average of all mines, and 2.5 times higher in strip mining. It is more significant that in 1955 worker productivity in the United States in bituminous-coal mines was 98 percent higher than in 1940, while in the U. S. S. R. it increased only 26.5 percent during the same period. In the United States underground productivity in bituminous-coal mines increased 70.3 percent; in the U. S. S. R. productivity for all underground mines under the Ministry of the Coal Industry reportedly increased about 11 percent. The greatest gain in productivity in the U. S. S. R. was in strip mining, which in 1955 was over 2.5 times that of 1940, compared with a 35-percent increase for United States bituminous-coal strip mines (excluding the more productive auger-mining development).

Although the U. S. S. R. is approaching the United States in coal output and emphasis is being placed on developing new, more productive, mechanical methods and work organization, the Soviet Union growth in mine-labor efficiency since 1940 has been less successful than that in the United States.

Because of the difference in the organizational structure of the socialized U. S. S. R. coal industry, exact comparison of employment in the Soviet Union and the United States cannot be made. It was reported in 1956, however, that 968,000 workers were employed in the coal industry of the U. S. S. R. During that year employment in the United States coal industry was reported at 257,163. From these data it appears that United States employment in the coal industry is about one-fourth that of the Soviet Union. Such a comparison is somewhat erroneous, because the Soviet coal industry employs workers for activities that in the United States are considered outside the industry. It is generally true, as indicated in the productivity data above, that almost four times more workers are employed in coal production in the U. S. S. R. than in the United States.

Coal Preparation

Coal preparation has been increasing in the U. S. S. R. as in the United States. In 1955, 101,258,200 metric tons of coal (25.9 percent of the total production) was treated in preparation plants in the U. S. S. R. In the United States 304,322,466 metric tons (72 percent of the bituminous-coal output) was mechanically cleaned. The extension of mechanical cleaning in both countries can be seen in the tabulation below, which shows the total coal treated and its share of each country's total output:

(Thousand metric tons)

Year	U. S. S. R. production	Percent mechanically cleaned	United States production[1]	Percent mechanically cleaned
1940....................	26,260	15.8	104,954	25.1
1945....................	12,284	8.2	156,851	29.9
1950....................	43,485	16.7	216,265	46.2
1955....................	101,258	25.9	304,322	72.2
1960 (planned).........	187,000	31.5	-	-

[1] Excludes anthracite.

The rapid strides in mechanical coal preparation in the U. S. S. R., broken only by the World War II when much of the equipment and many mines of the western part of the world were destroyed, will be continued during current national economic plans, and 61 new coal-preparation plants will be constructed. By the end of 1960 about 30 percent of the total production will be cleaned. About 110 million metric tons of the total 187 million tons of coal treated in preparation plants in 1960 will be coking coal; approximately 93 percent of all the coking coal produced in 1960 will be cleaned. The preparation of coking coals at the new plants in 1960 will represent 30 percent of the Donets, 20 percent of the Kuznetsk, and 60 percent of the Karaganda Basins' total volume of prepared-coal output.

There also will be an increase in the preparation of coal used in electric-power production. From approximately 30 million tons treated and used in power production in 1955, a planned goal of 76 million tons was set for 1960.

INTERNATIONAL COAL TRADE

Foreign trade in coal and coke, which was less than 2 percent of production in 1957, has not figured importantly in the Soviet coal industry. The economy of the U. S. S. R. is not burdened with coal surpluses, although for reciprocal trade or the fulfillment of bilateral or multilateral trade agreements significant gains in coal exports were made in recent years. Owing to increased coal exports in the later post-World-War-II years, the Soviet Union has emerged as a net-coal-exporting country. In 1957, a total of 994,000 metric tons of anthracite and bituminous coal was exported to countries of the European Coal and Steel Community, compared with 1,175,000 tons in 1956. Over half of the quantities delivered in 1956 and 1957 went to France, where a market has developed largely for Donets Basin anthracite. Italian imports from the U. S. S. R.

amounted to 244,000 metric tons in 1957, and the remaining Western European coal imports from the Soviet Union showed a considerable decrease from the 1956 level and were of no great importance.

Among the Eastern European countries, however, economic and political ties are stronger than in Western Europe and coal figures more prominently in the international trade of the area. In 1956 about 21 percent of the total Polish coal production was exported; this was the major item in the country's total foreign trade. During 1956 Poland exported about 6.7 million tons of coal to the U. S. S. R., an abrupt decline from the 8.6 million tons exported in 1955.

Czechoslovakia, East Germany, and Poland exchanged coals to help meet specific quality demands and to utilize surpluses in some grades and qualities. East Germany, however, is the largest foreign consumer of Soviet coals. East Germany produces largely brown coals, and the economy sorely lacks indigenous bituminous coal. In 1956 East Germany imported 2,694,000 metric tons of coal and 921,000 tons of coke from the U. S. S. R. Hungary and Rumania are also poor in coking-coal resources and imported 421,000 and 414,000 metric tons of coke, respectively, in 1956. The Soviet Union supplies about 60 percent of the Hungarian coke requirements and most of the Rumanian coke imports, although both countries also import coke from Poland. Virtually all of the small coke requirement of Bulgaria is imported from the Soviet Union.

Finland has become a major importer of Soviet coals. Under new and existing trade agreements, coal shipments to Finland in 1958 will be nearly doubled. During the year a total of 820,000 metric tons of coal and coke will be shipped from the Soviet Union as compared with 430,000 metric tons in 1957. In 1957 200,000 tons of anthracite, 150,000 tons of bituminous coal (including 30,000 tons of coking grade), and 80,000 tons of coke were shipped.

Yugoslavia plays an important role in the Soviet Union coal-export trade. In contrast to France and Finland, which import large quantities of Soviet anthracite, bituminous coal, and coke for space heating, Yugoslav imported coal is used almost exclusively for production of metallurgical coke. Trade agreements signed in 1958 provided for the delivery of about 800,000 tons of Soviet coal annually, but the vacillating political differences between the two countries may have an adverse effect on the stability of their coal trade.

CONSUMPTION

Consumption figures for the total Soviet coal supply, as reported for the past few years, show the largest consumers to be the railways, ferrous metallurgy, and electric powerplants. A breakdown of coal consumption by some major consumers in the U. S. S. R. and the United States in 1956 was reported as follows (9):

	U. S. S. R., percent	United States, percent
Rail and water transport	23	3
Ferrous metallurgy:		
Coke manufacturing	15	24
Energy use	6	1
Powerplants	19	35
Use at mines	6	2
Other use	26	35

NOTE: Bituminous coal and lignite only; figures include coal used at mines and exclude foreign bunkers. All data rounded.

Although a detailed comparison cannot be drawn, some observations on the principal features of Soviet coal consumption can be made. While 23 percent of the Soviet coal supply was consumed by rail and water (almost wholly rail) transport, in the United States coal shipments to railways in 1957 dropped to a new low and accounted for about 3 percent of the total coal consumption. About one-third of the United States coal is used in electric powerplants as compared with about one-fifth in the U. S. S. R. Coke plants account for one-fourth of the United States coal consumption, but less than one-sixth of Soviet coal is used for that purpose. Specific data for other individual coal-consumer groups included under "Other use" are not available in enough detail for a direct comparison.

CHANGES IN COAL-INDUSTRY ORGANIZATION

Until recently, except for coal mines that organizationally bear some similarity to captive mines in the United States, most of the Soviet coal industry came under the jurisdiction of the Ministry of the Coal Industry; some areas were under the ministries of the individual republics.

In 1957, according to G. F. Mikheyev (3), newly created National Economic Councils were established for the various economic regions of the economy. The National Economic Councils direct subordinate industrial organizations and other production, construction, technical material supply offices and bases, and other industry groups, which had been subordinate to the Ministries of the Soviet Union and the ministries of the individual Republics as well as the industrial organizations of the Republics in part.

The Soviet coal industry's "combinats," "trusts," and other production units come under the jurisdiction of the National Economic Councils.

"Combinats" manage all the productive activity of trusts; they execute the decisions of the Party, the Government, and the National Economic Councils; they formulate current and future plans, render technical and organizational aid to the trusts and mines, and take part in the technical-economic work of the National Economic Councils. Trusts and ore (mining) directorates are directly responsible to the combinats.

"Trusts" (and mining directorates) manage operation of strip and deep mines in coal production. Under a trust manager and his deputy, functional divisions for operations, such as production, capital construction, technical services, administration, planning, and personnel, are directed in the management of the coal-producing enterprise.

Besides the trusts at the outset of commercial operations there is a Division of Technical-Material Supply; a Loading-Transportation Directorate, and a Labor-Supply Division.

RESERVES

According to the most recent (1958) information published by the U. S. S. R. the total geological coal reserves (total in situ reserves of the U. S. S. R.) were estimated at 8,669,510 million metric tons. of which 241,210 million tons were measured, 941,890 million tons indicated, and 7,486,410 million tons inferred. Approximately 27 percent of the total reserves are within 300 meters of the surface, about 20 percent at a depth of 300 to 600 meters, 33 percent at depths ranging from 600 to 1,200 meters, and 20 percent at depths of 1,200 to 1,800 meters.

Mining conditions generally are more difficult in the western coalfields, and except in the Donets Basin the quality of the coal is lower than in the eastern regions. In the Donets Basin the mines are gassy, deep, more costly to operate, and generally less productive than the eastern mines, in which many deposits are favorably disposed to surface mining. To compensate for the shortfall in coal output and to conserve the higher quality coals in the western part of the U. S. S. R., lignite production is being developed in the Ukraine and also in the eastern regions. The planned increase in output of the Donets Basin is to eliminate or reduce long rail haulage of eastern-area coals - a movement that involved about 14 million tons of coal in 1955.

The quality problem is seen in the Soviet coking-coal supply. Only two coke-chemical plants in the eastern regions are near a coal supply (in the Kuznetsk Basin). Others elsewhere in the eastern regions obtain coal from places 1,200 to 2,200 kilometers away. Although metallurgical and coke-chemical industries will be constructed in many eastern areas under current and future economic plans, the supply of the country's coking-coal requirements is complicated by the diversity of location of the types and qualities of coking coals, the proportion of coking coals in the total reserves of a given area, and the degree of development of the area. In 1955 about 77,630,000 metric tons of coking coal was produced. Most of the coking coals originate in the Donets, Kuznetsk, and Karaganda Basins and a smaller share comes from the Pechora and Kizel' Basins. Some coking coals are also produced in the Georgian S. S. R., in the Caucasus, and on Sakhalin Island in the Far East. About one-third of the total output of the largest basins is coking coal, which in Soviet literature is usually termed "technological" fuel as distinguished from coals for steam raising or heating. The term applies to all coals used in coking, chemical, and similar processes.

Soviet coal types, designations, and major uses are as follows:

	Symbol		Volatile matter of combustible mass,1/ percent	
Common name	Russian	English		Use
Brown coal (lignite) ...	Б	B	40-65	Fuel and chemical processing.
Long-flame coal (high-volatile-bituminous) ..	Д	D	> 42	Do.
Gas coal	Г	G	35-44	Fuel.
Steam fat coal (medium-volatile-bituminous) ..	ПЖ	PZh	26-35	Coking.
Coking coal	К	K	18-26	Do.
Steam-coking coal (low-volatile-bituminous) ..	ПС	PS	12-18	Do.
Lean coal (semi-anthracite)	Т	T	6-17	Fuel.
Anthracite	А	A	< 6	Do.

1/ Moisture- and ash-free.

A list of the principal coking-coal-producing basins, the percentage of coal reserves by type, and the percentage of output by types follows (9):

Basin and type of coal	Total geological reserves, percent	Measured and indicated reserves as of Jan. 1, 1956, percent	Output in 1955, percent
Donets Basin:			
High-volatile	11.5	13.1	16.3
Medium-volatile	5.1	7.5	8.6
Low-volatile, coking	7.1	5.8	5.3
Gas	1/ 30.3	1/ 33.3	14.7
Coals for power generation	46.0	40.3	55.1
Total	100.0	100.0	100.0
Kuznetsk Basin:			
High-volatile	3.8	7.5	15.3
Medium-volatile, coking	2.5	15.8	19.7
Low-volatile	5.0	9.8	10.9
Gas	-	20.8	13.2
Coals for power generation	87.4	32.1	40.9
Other	1.3	14.0	-
Total	100.0	100.0	100.0
Karaganda Basin:			
High-volatile	0.8	14.6	7.4
Medium- and low-volatile, coking	12.4	38.4	12.1
Other	86.8	47.0	80.5
Total	100.0	100.0	100.0
Pechora Basin:			
High-volatile	7.5	60.2	42.6
Low-volatile, coking	6.2	6.3	-
Other	86.3	33.5	57.4
Total	100.0	100.0	100.0

1/ Includes coals for electric-power generation.

CONCLUSIONS

The Soviet coal industry is aware of the shortage in coking coal reserves, their unfavorable distribution and inadequate production. The industry's development policy has been directed toward minimizing these obstacles to further economic growth. During the current economic plans, the supply of certain types of coal will remain critical. Shortages will persist until a new productive capacity comes into operation, and the share of coking coal in the total coal output will become more balanced (9).

Few of the problems encountered in the Soviet Union development of its coal reserves apply in the United States. If a comparison were drawn on a comparable basis, it would be of little importance which country has the most coal measured to the last ton. The coal reserves of both countries are more than adequate for hundreds of years at the present rates of extraction. The United States coal deposits, however, offer more favorable mining conditions and yield generally higher quality coals. The coalfields are better situated in relation to the industrial centers of the nation, and selective mining (permitted by the very magnitude of reserves) through competitive markets has resulted in the highest productivity, the lowest B.t.u. costs, and the highest quality of marketable coals for internal and foreign markets.

APPENDIX - BRIEF DESCRIPTION OF COAL BASINS AND REGIONS OF THE U. S. S. R.[5]

The U. S. S. R. possesses huge reserves of minable coals of varying qualities.

The geographical distribution of hard-coal deposits in the territories of the U. S. S. R. is given in figure 1, from which it can be seen that in the European part of the U. S. S. R., with its dense population and railway network, and its highly developed industry, there are only three large coal basins: The Donets, Sub-Moscow, and Pechora Basins (not counting the deposits of the Lvov-Volynsk coal region or the brown coals along the right bank of the Dnieper River).

In the eastern regions of the U. S. S. R. there are more than 20 known coal deposits (regions). The principal resources of minable coal are centered in the Kuznets and Karaganda Basins, in the Minusinsk lowlands, the Kansk-Achinsk and Irkutsk Basins, and also in the extensive coal-bearing areas in the Tunguska and Lena River regions.

By types, all coal reserves of the U. S. S. R. consist of brown coals (12 percent), and bituminous-coal, and anthracite (88 percent).

Some data on the various coal basins, the technical-economic characteristics, their share in the total production, and other factors are shown in table 3.

Donets Basin

The Donets Basin supplies the largest share (36 percent) of the total U. S. S. R. coal production. More than half of the coal is mined from seams less than 1 meter thick. The average thickness of seams being worked in the Donets Basin does not exceed 0.9 meters. More than 70 percent of the coal production comes from seams of 0° to 30° pitch. Workings are from 100 to 1,000 meters below the surface, and 40 percent of the mines are at a depth of 300 meters. Seventy-four percent of all the mines are gassy, and 34 percent of these are classified as very gassy; 50 percent of the mines also have dangerous dust problems.

The Donets Basin is the largest high-quality coking-coal-producing region in the U. S. S. R. About 60 percent of all the metallurgical coke in the U. S. S. R. is produced from Donets coals.

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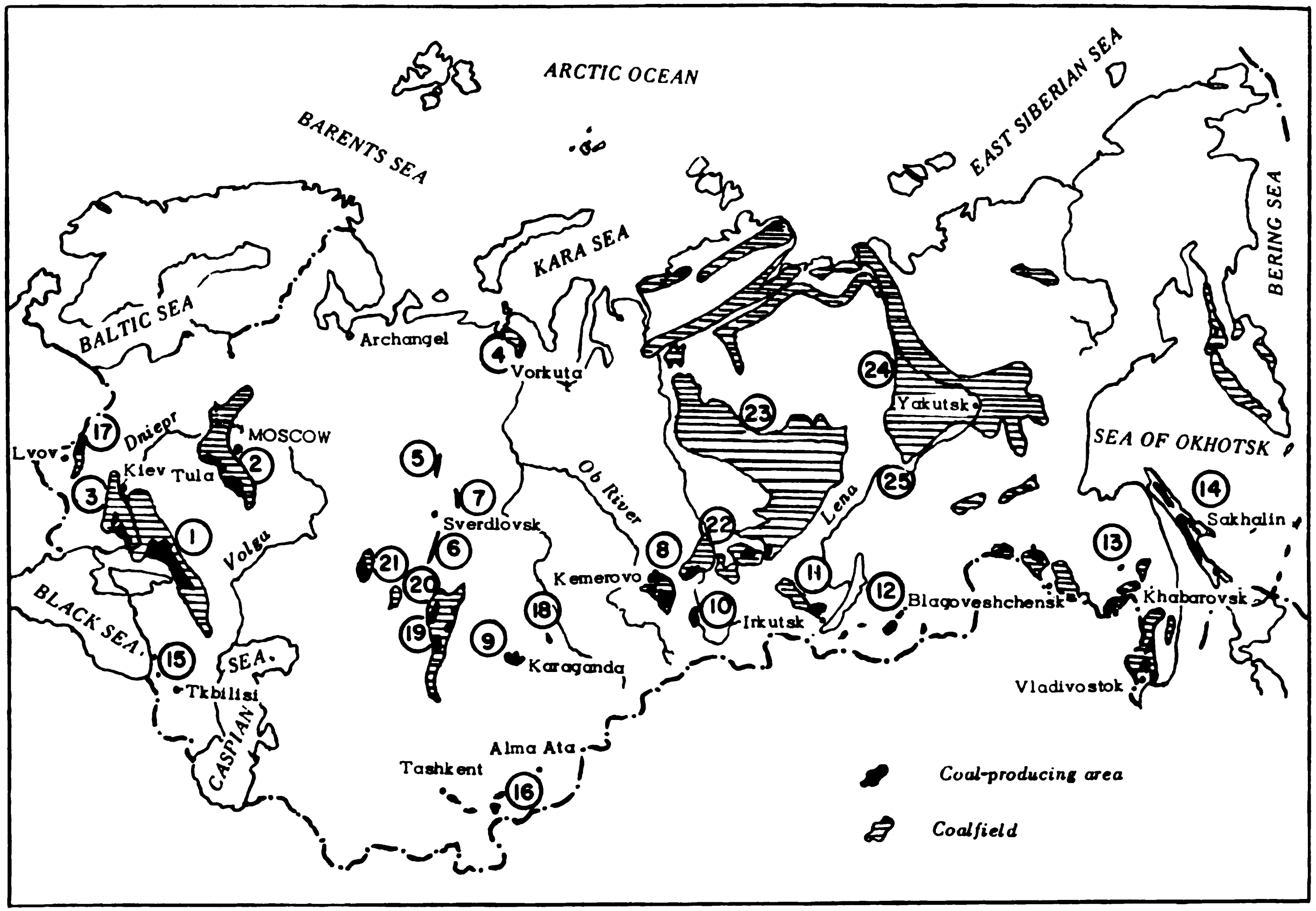
[5] Translation from Mikheyev, G. D., Ekonomika Organizatsiya Proizvodstva i Planirovaniye v Ugol'noi Promyshlenosti S. S. S. R. [Economics, Organization of Production and Planning in the Coal Industry of the U. S. S. R.] Ugletekhizdat, Moscow, 1957, pp. 20-30. More recent data indicate that the U. S. S. R. is first in world coal reserves. See "RESERVES" on page 14.



1. Donets Basin
2. Sub–Moscow Basin
3. Dniepr Basin
4. Pechora Basin
5. Kizel Basin
6. Chelyabinsk Basin
7. Sverdlovsk Deposits
8. Kuznetsk Basin
9. Karaganda Basin
10. Minusinsk Basin
11. Irkutsk Basin
12. Transbaikal Deposits
13. Far East Deposits
14. Sakhalin Island Deposits
15. Georgian SSR Deposits
16. Central Asian Deposits
17. Lvov–Volynsk Region
18. Ekibastuz Deposits
19. Kushmurun Deposits
20. Orsk Brown-Coal Region
21. South Ural Brown-Coal Region
22. Kansko–Achinsk Basin
23. Tunguska Coal-Bearing Region
24. Yakutsk Coal-Bearing Region
25. Lena Coal-Bearing Region

FIGURE 1. - Coal Basins and Producing Areas, U. S. S. R.

TABLE 3. - Principal coal basins and deposits, basic data and characteristics, the U. S. S. R., 1955

	Donets Basin			Sub-Moscow Basin	Kusnetsk Basin	Karaganda Basin	Pechora Basin	Urals			
	Total	Ukrainian Donbas	Shakhtantratsit					Total	Kizel' Basin	Chelyabinsk	Sverdlovsk
Production of mines under Ministry of Coal Industry ... percent of total	35.9	29.7	6.2	10.4	15.0	7.1	3.8	12.4	2.9	4.7	4.3
Distribution of coal production, percent:											
Seam thickness:											
Less than 1 meter	55.0	58.3	39.5	.3	4.6	2.8	15.7	11.3	21.7	1.6	6.4
1.0 to 3.5 meters	45.0	41.7	60.5	89.8	55.8	54.6	73.7	57.6	74.7	37.7	92.2
More than 3.5 meters	-	-	-	9.9	39.6	42.6	10.6	31.1	3.6	60.7	1.4
Degree of seam pitch:											
Slight	70.7	67.2	87.4	100	36.1	96.4	66.7	44.0	27.2	59.2	59.1
Medium	12.1	12.8	9.0	-	19.3	2.9	29.3	29.8	34.6	25.2	28.1
Steep	17.2	20.0	3.6	-	44.6	.7	4.0	26.2	38.2	15.6	12.8
Strip-mining production ... percent of total	-	-	-	-	10.0	31.1	-	50.5	-	36.9	93.6
Productivity per worker, monthly average:											
Metric tons	25.8	24.7	32.4	42.0	46.7	62.4	37.7	61.1	33.2	56.4	147.5
Percent of average for Ministry of the Coal Industry	68.3	65.3	85.7	111.1	123.5	165.1	99.7	161.6	87.8	149.2	390.3
Costs per ton of coal:											
Ministry of Coal Industry ... percent of average	130.0	-	107.5	([1] 81.6 (92.5	84.5	65.4	-	-	129.1	70.8	33.4
Average ash content of coal .. percent	14.5	14.6	14.0	29.4	10.5	21.0	19.2	24.8	24.7	28.3	20.9

	Central Asian deposits	Eastern Siberian deposits	Far Eastern deposits				Georgian S. S. R.
			Total	Primorsk	Dal'vost'	Sakhalin	
Production of mines under Ministry of Coal Industry ... percent of total	1.7	6.2	4.3	1.4	1.9	1.0	0.7
Distribution of coal production, percent:							
Seam thickness:							
Less than 1 meter	1.4	.6	8.1	6.8	-	11.9	7.7
1.0 to 3.5 meters	26.9	61.5	81.1	84.7	100	71.5	42.6
More than 3.5 meters	71.7	37.9	10.8	8.5	-	16.6	49.7
Degree of seam pitch:							
Slight	61.6	99.3	69.9	78.7	100	48.5	41.6
Medium	27.8	-	21.5	12.8	-	41.3	55.5
Steep	10.6	.7	8.6	8.5	-	10.2	2.9
Strip-mining production ... percent of total	33.5	47.0	44.4	-	93.5	16.3	-
Productivity per worker, monthly average:							
Metric tons	34.8	77.0	48.4	33.9	154.3	28.8	33.4
Percent of average for Ministry of the Coal Industry	92.4	203.7	128.0	89.7	408.2	76.2	88.4
Costs per ton of coal:							
Ministry of Coal Industry ... percent of average	109.5	54.7	-	120.5	40.8	244.0	133.7
Average ash content of coal .. percent	14.1	15.3	15.5	22.4	10.6	14.2	30.3

[1] Figure for Moskvaugol' Combinat and Tulaugol' Combinat.

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In recent years new, large coal deposits were discovered and developed in the western part of the Donets Basin and the Dnepropetrovsk Oblast'. These coal-bearing deposits have 5 to 12 low-pitch seams, each 0.6 to 1.8 meters thick and covered with a large layer of loose rock 60 to 200 meters thick. The coals are characterized by their high quality (principally gas coals and coking coals with low ash and sulfur content). This region of the Donets Basin represents a large reserve for development of the coal industry.

During the Fifth Five-Year Plan, coal regions were discovered in the northern part of the Donets Basin (from Lisichansk to Millerovo). This area has gas coals, long-flame (high-volatile bituminous) coals, and mixed gas and coking coals. Coking coals were found in the Tatsinsk deposits in the Kamesk Oblast' on the extreme eastern edge of the basin.

Because of these new coal discoveries, the borders of the Donets Basin were extended considerably. The Donets Basin is the principal supplier of energy (electric-power generation) and technological fuel for industry and transport in the European part of the U. S. S. R. Donets Basin coal is a base for numerous uses in metallurgical plants, the machine-construction industry, thermal-power stations, and a whole series of other undertakings centered largely in the southern part of the country.

Sub-Moscow Basin

More than half of all brown-coal reserves of the Sub-Moscow Basin are in the Tula Oblast'; smaller reserves are found in the Kaluga, Ryazan', and Smolensk Oblast's.

The Sub-Moscow Basin coals are characterized by their shallow depth. In the main part of the basin seams usually are 30 to 70 meters below the surface.

The mines in the Sub-Moscow Basin are being constructed and developed under complicated hydrogeological conditions, which make voluminous work on water problems necessary.

Coal seams 0.9 meter thick containing less than 45 percent ash are being worked in the basin. About 90 percent of the coal comes from seams 1.2 to 3.5 meters thick. The average thickness of seams now being worked is 2.1 to 2.3 meters.

The coal seams are deposited in rolling, wavelike formations that are complicated by Karst interruptions.

The Sub-Moscow Basin plays an important role in the fuel supply of Moscow and the central Oblast's of the U. S. S. R.

Sub-Moscow Basin coals, regardless of their high ash and moisture content, are good energy (electric-power generation) fuels and are burned very effectively in suspension in large thermal-power stations (Stalinogorsk, Shchekinsk, Cherepovets, and others). The gas industry is being developed on Sub-Moscow coals and supplies combustible gas to Moscow and other industrial regions and cities.

It should be noted that Sub-Moscow brown coals, blended with Donets coals, were more economical than Donets coals used alone as steam-engine-boiler fuel.

During the past 15 years the Sub-Moscow Basin has undergone considerable development. In 1955 coal production was four times the 1940 output.

Dnieper Basin

The Dnieper Basin is mainly on the right bank of the Dnieper River and forms a large zone of brown-coal deposits of considerable size, with coal seams at shallow depths extending from Zaporozhe to Zhitomir.

The average seam thickness is 3 to 5 meters, with a maximum of 26 meters.

The coal is brown and earthy and has a high moisture content. The useful energy of the fuel averages 2,000 kilocalories per kilogram. Ash content varies from 11 to 40 percent or more. The middle seams usually contain less ash. Production is mostly strip mined. The chief use of the coal is in electric-power production.

Pechora Basin

The Pechora Basin is in the northeastern part of European U. S. S. R., largely within the boundaries of the Komi A. S. S. R. and partly in the Archangelsk Oblast'. The basin contains huge coal deposits, of which coking coals are especially significant. More than 65 percent of the developed reserves are in the Vorkuta and Inta deposits, which are the most developed in an industrial sense.

Vorkuta coals are the principal components of coking blends of the Cherepovets' metallurgical plant, and after rail connection with the Urals is made Vorkuta coals will be used also in metallurgical plants of this region.

The basin plays an important role in supplying fuel for industry and transport in the European north and northeast regions, wherein lies the large industrial center of Leningrad.

All active mines of the basin are gassy. The seam dip generally is low (under 30°); about 70 percent of the production comes from seams of less than 30° pitch. Coal is being mined from seams 0.5 to 4.6 meters thick, with an average thickness of 1.47 meters.

The rapid development of coal production in the Pechora Basin began in the postwar years.

Ural Coals

During Soviet administration the Urals, with their inexhaustible mineral resources, became the largest industrial center of the country.

Despite the great development of the coal industry of the Urals, its fuel requirements, and especially coking-coal requirements, are far from being met fully. A considerable quantity of coal is brought to the Urals from the Kuznetsk and Karaganda Basins.

The coal deposits of the Urals are centered principally in the Kizel' and Chelyabinsk Basins and also in the Sverdlovsk Oblast'.

Kizel' Basin

The Kizel' Basin is in the Perm Oblast'. The basin contains relatively small, irregular coal deposits. Seam thickness varies between 0.5 and 4.5 meters, and about 80 percent of the coal comes from seams over 1 meter thick. Workings of some of the mines of this basin are 700 to 800 meters deep.

The deposits are characterized by much folding, complicated geological conditions, frequent disturbances, and erosion of the seams. Twenty-five percent of the coal comes from seams having up to 30° pitch, about 35 percent from seams having up to 45° pitch, and more than 38 percent from seams exceeding 45° pitch.

Kizel' coals are gas and medium-volatile coking coals. Their useful calorific value is 5,400 kilocalories per kilogram. Because of their high sulfur content the coals are used predominantly for energy production (electric-power generation), and only a small quantity is used for technologic purposes in light metallurgy and for coking.

About 30 percent of the mines in the basin are working gassy seams.

Chelyabinsk Basin

The Chelyabinsk Basin is east of the town of the same name.

The coal seams are characterized by a complicated structure and varying seam thicknesses. Some deposits have 22 seams. In the Korkinsk district the coal deposits measure 150 to 200 meters in thickness and at Emanzhelinsk, 40 meters in thickness. In other districts of the basin the seam thickness does not exceed 3 to 4 meters.

The coal is brown and low in sulfur and has under 25 percent moisture content. It is used for energy (electric-power-generation) purposes and to a lesser extent for the production of generator gas.

The coal deposits lie at a shallow depth; 66 percent of the coal production comes from mines working at depths of 150 meters or less. About 60 percent of the coals are obtained from low-pitching seams (up to 30°).

Production, by seam thickness, is shown in table 3. More than 60 percent of the mines are working gassy seams. In the Korkinsk district about 40 percent of the basin's total production is strip mined.

Sverdlovsk Deposits

The Sverdlovsk deposits are grouped in various coal-bearing regions, as follows: Serovsk, Yegorshinsk, and Bulanash-Yelkinsk. The Serovsk coal-bearing district is the most significant industrially. The deposits of Volchansk, Bogoslovsk, and Veselovsk are in this district and are being fully developed by strip mining.

The total coal thickness of these deposits reaches 100 meters. The coal is brown, of medium and high ash with a high moisture content, and is used in electric-power production.

The Yegorshinsk district coals are semianthracites. The deposits are lenticular and greatly disturbed.

The long-term development of coal production at the Yegorshinsk deposits is related to development of lower horizons that are complicated by the presence of a high amount of gas.

Bulanash-Yelinsk District

This district contains bituminous coal ranging from gas coals in the north to long-flame coals in the south. Coal reserves are inequally distributed, with interruptions of coal deposits by barren areas and gradual consolidation toward the south.

Hydrogeological conditions are characterized by large water pockets covering the coal seams.

Kuznetsk Basin

The Kuznetsk Basin is in the Kemerovo Oblast'; only its most westerly sector falls in the Novosibirsk Oblast' and its southern part falls in the Altaisky Kray.

The basin is characterized by its huge coal reserves. In the Kemerovo region there are 40 workable seams with a total thickness of about 70 meters.

In the Prokopyevsk-Kiselevsk region are 26 workable coal seams with a total thickness of 80 meters. Some coal seams attain a thickness of 20 to 30 meters, and in the neighboring Bachatsk region the seam thicknesses reach 40 to 50 meters.

In the Leninsk coal region there are over 60 workable coal seams, 2 to 4 meters thick, with favorable mining-geological conditions.

On the other hand, the Anzhero-Sudzhensk region is characterized by great complication in deposition of seams and their disturbance.

In the southern regions of the Kuznetsk Basin coal seams are deposited largely in folded structures and complicated by geological disturbances that, with coal saturation (rich, coal-bearing), the proximity of the coal seams, the high yield of gas, and the tendency to spontaneous combustion, make mining difficult. The seams are of low, medium, and steep pitch.

A considerable part of the basin is suitable for strip-mining methods.

All mines of the Kuznetsk Basin are gaseous, and over 25 percent are in the upper category. The average thickness of seams being worked is 2.1 meters. More than 90 percent of the coal comes from seams over 1 meter thick, including about 22 percent from seams over 6.5 meters thick.

Steeply pitching seams yield about half of the entire production of the basin.

There are ambitious plans for developing the new Tom'-Usinsk area in the south of the Kuznetsk Basin, where about 10 percent of the total developed (investigated) reserves of the basin occur. The coal-bearing measures of the area contain 33 workable coal seams with a total coal thickness of 87 meters. Some seams are 8 to 10 meters thick. The coal seams of this area are largely undisturbed and pitch 6° to 15°. The area has huge coking coal reserves.

Development of the area began in 1947. In 1956 a large-scale slope was operating, and construction of a second large slope and a strip mine was under way. Because of the great thickness of seams, the shallow depth, and the varied (broken) relief, a considerable part of the reserves of the area can be worked by strip or slope mines.

Under the Sixth Five-Year Plan 2 strip mines with a combined capacity of 9 million tons annually are to be constructed here.

In 1956 more than 13 percent of the Kuznetsk Basin's total coal production was strip-mined.

Kuznetsk coals vary greatly in quality; coals of all types range from brown coals to anthracites. More than 30 percent of the measured reserves of the Kuznetsk Basin are coking coals.

The Kuznetsk Basin ranks second to the Donets Basin in coal production. Reserves of coking coal and coal for electric-power generation are calculated in many billion tons. The basin is the principal fuel base for the metallurgy of the Urals and Siberia. Considerable quantities of Kuznetsk coals are used for rail transport and energy production in western Siberia, the Urals, and Central Asia.

Karaganda Basin

The Karaganda Basin is in the northeastern part of the Karaganda Oblast' in the Kazakh' S. S. R.

The basin is significant in industry and metallurgy, because more than half of the reserves of the basin are coking coals.

In the Karaganda region there are more than 20 seams of workable thickness with a 20° to 30° pitch. Seam thickness varies between 1 or 2 meters and 5 or 6 meters.

About one-third of the mines are working seams 50 to 200 meters below the surface. The rest of the mines work at depths of not more than 300 meters. A majority of the mines are very gassy, and all mines have dust problems.

The new Churubai-Nurinsk and Tenteksk districts have utmost significance in the further development of the Karaganda Basin. Large reserves of low-ash coking coal have been found in these districts, which contain up to 11 workable seams of coking coal that have a total thickness that exceeds 25 meters.

Minusinsk Basin

The Minusinsk Basin is in the Khakask Autonomous Oblast' of the Krosnoyarsk Kray in the vicinity of the town of Abakan. The largest deposits are the Chernogorsk and Izykhsk.

Deep mining (shaft) is practiced at the Chernogorsk deposits, 3 to 4 seams very close to each other are 2.5 to 4.0 meters thick. The seams dip at an angle of 20°. The coal is high-volatile bituminous and has an ash content of 10 to 15 percent. It is used as energy fuel in thermal-power production. Because there are no consuming centers in the producing area, most coal is shipped beyond the borders of the Khakask Autonomous Oblast'.

In the southern part of the Chernogorsk deposits some of the coal will be strip-mined during the Sixth Five-Year Plan. The Izykhsk deposits represent a future coal-development area of the basin. These deposits can also be developed by strip mining.

Irkutsk Basin

The Irkutsk Basin is in the southwest part of the Irkutsk Oblast'. The basin extends 500 kilometers and is 80 kilometers wide. It has not been fully investigated. The best known deposits are those of the Cheremkhovo, the reserves of which comprise about 30 percent of the total investigated to date. Coal is mined at the Cheremkhovo deposits and at the small deposits of Zabitaisk and Vladimirsk, which are adjacent to Cheremkovo.

The coal seams are pitched gently. Over 50 percent of the coal output is strip-mined.

Within the basin both bituminous coals and lignites of varying ash content have been found. The Cheremkhovo coal is usually high-volatile bituminous, with an average ash content of 16 to 20 percent.

At the end of the Sixth Five-Year Plan a large quantity of Cheremkhovo coal will be used in chemical processing and in large-scale powerplants. At present the principal consumers of Cheremkhovo coals are the railways and the chemical industry.

During the Sixth Five-Year Plan development of the Aseisk brown-coal deposits is planned near the town of Tulun, where large-scale strip mining can be used in producing low-ash brown coal.

Coal Deposits of the Transbaikal

Many coal deposits have been reported in the Transbaikal, although the area covered by the coal seams is not large.

Coal is now being produced at the following deposits: Tarbagataisk, Chernovsk, Arbagarsk, Bukachachinsk and Kharanorsk in the Chitinsk Oblast', and Gusino-Ozersk in the Buryat-Mongolian A. S. S. R.

Coals of the Bukachachinsk deposits are bituminous, and the others, lignites. Because of limited reserves, there are no great development plans for the Tarbagataisk, Chernovsk, and Bukachachinsk deposits.

The most promising are the Gusino-Ozersk and particularly the Kharanorsk deposits. At the Kharanorsk deposits one strip mine is in operation, and several additional strip mines are planned. The opening of strip and deep mines is also planned for the Gusino-Ozersk deposits. These deposits are 120 kilometers from Ulan-Ude on the shores of Gusinskoye Lake. Investigations have revealed 20 coal seams 1 to 5 meters thick. Some seams reach a thickness of 20 meters. All seams are of complicated structure, with clay or clay-shale partings. The coals are lignites with an ash content of 10 to 20 percent.

The coals of the Transbaikal deposits are consumed largely by railways.

Coal Deposits of the Far East

In the Far Eastern regions coal is mined at the Raichikhinsk lignite deposits in the Amursk Oblast', at the Urgal'sk deposits in Khabarovsk Kray, which comprise the great Buryeya bituminous-coal basin, and at numerous deposits in the Primorsk Kray and the Sakhalin Oblast'.

The Raichikhinsk deposits are characterized by the shallow depth of the coal seams (50 meters or less). The seams are flat, and the coal is strip-mined. There are 3 coal seams at the coal deposits; 1 seam reaches a thickness of 5 to 6 meters.

The coal is a lignite with an ash content up to 40 percent and a moisture content (on a useful-energy basis) of 8 to 17 percent. It is used in thermal-power generation. In the Sixth Five-Year Plan some of the Raichikhinsk coal will be briquetted.

The Buryeya Basin is on the upper reaches of the Buryeya River about 300 kilometers from the Far Eastern Railway.

The Primorsk Kray coal deposits are bituminous (Suchansk, Lipovyetsk, Voroshilovsk, and Podgorodnyensk) and lignitic (Artemovsk and Tavrichesk).

Coal is deep-mined in all developed deposits of the Primorsk Kray; however, in the future strip mines may be opened at the Lipovyetsk deposits. The coals are of relatively high ash content, and most of the deposits hold little promise for development - particularly the Suchansk deposits.

The further development of coal production in the Far East must depend on the investigation of new coal regions.

Sakhalin Oblast'

In the Sakhalin Oblast' coal is produced at Aleksandrovsk, Ugleyegorsk, Kholmsk, Yuzhno-Sakhalinsk, and the Makarovsk districts. The Sakhalin deposits are characterized by their great variety and complicated mining-geological conditions. The thickness of the workable coal seams varies between 0.7 to 6.0 meters or more.

Sakhalin produces coal of various types. About 80 percent of the production consists of high-volatile bituminous and brown coals. There is little coking coal.

The most promising district is the Uglyegorsk, which contains gas coals used as bunker fuel for ships and in thermal-power generation. Some Uglyegorsk coals can be used in coking.

Coal Deposits of the Georgian S. S. R.

In the Caucasus are many small coal deposits; only a few (the Tkvarcheli, Tkibulsk, and Akhaltsykh) are of significance for the industrial development of Georgia. All Georgian coals are high in ash.

Many of the coal seams are reached by shafts or slopes. The Akhaltsykh brown-coal deposits are mined by vertical shafts. Coals of some seams of the Tkibulsk and Tkvarcheli deposits are used in the coke-chemical industry; others are distributed to electric powerplants and for local use.

New coal-bearing areas have been found recently in the Tkibulsk at higher elevations and enhance somewhat the planned development of the coal industry of Georgia.

Coal Deposits of Central Asia

Coal production in central Asia is taking place at the following deposits: Kok-Yangaksk, Tash-Kumirsk, Kzyl-Kiisk, and Sulyutinsk in the Kirgiz S. S. R.; Angrensk in the Uzbek S. S. R.; Shurabsk in the Tadzhik S. S. R.; and Lyengersk in the Kazakh S. S. R.

The coals of all these deposits, except the Kok-Yangaksk and the Tash-Kumirsk, are brown coals.

The coal deposits of central Asia usually are in mountainous areas with relatively complicated geological conditions.

The coal seams have a thickness of 1 to 6 meters, sometimes reaching 12 to 16 meters. The pitch of the coal seams varies from 12° or 15° to 50° or 70°. Strip mining is practiced only at the Angrensk deposits (the seam is 30 to 60 meters thick), where future development holds great promise.

Because of the rapid rise of industrial-fuel requirements in central Asia, including southern Kazakhstan, considerable quantities of coal are being brought in from Karaganda.

New Coal Basins and Deposits

Because of the extensive geological prospecting in many places in the U. S. S. R. in recent years, large coal deposits of great national economic significance were discovered.

The Lvov Volynsk region is in the basin of the western Bug River in the northwest part of the Lvov and the southwest part of the Volynsk Oblast's of the Ukrainian S. S. R.

The coal seams lie at a depth of 300 to 600 meters and are overlain by 280 to 450 meters of water-bearing, cretaceous marl. The coal measures contain 1 to 4 workable coal seams, 0.5 to 2.0 meters thick. The average seam thickness is 0.8 to 1.2 meters and the dip 1° to 2°. The coals resemble the high-volatile bituminous coals of the Donets Basin in quality and are high-quality fuels for electric-power generation.

The deposits are characterized by exceptionally difficult hydrogeological conditions, but mines were opened because of a shortage of Donets coals. During the Fifth Five-Year Plan, three mines were brought into production; several new mines are planned for the Sixth Five-Year Plan.

Ekibastuz bituminous-coal deposits are in the Pavlodarsk Oblast' of the Kazakh S. S. R. in the form of a large, enclosed syncline about 25 kilometers long and 9 kilometers wide. The northern part of the deposits is traversed by the Southern Siberian Railroad.

Four seams at close intervals, each 13 to 16 meters thick, are industrially significant. The seams are complicated in structure, and their total thickness is 160 meters at a maximum depth of 350 to 400 meters. The coal outcrops along the periphery of the syncline.

Reserves of the deposit are placed at several billion tons. The coals have a hard structure and a high ash content (34 to 45 percent) and are difficult to beneficiate; however, the calorific value is rather high (at more than 4,200 kilocalories per kilogram), which makes the coal suitable for thermoelectric-power generation. Coal from these deposits is being used and will be extended to supply new large-scale electric powerplants of the Urals, Omsk, and Pavlodar. Only one large-scale strip mine is in operation now.

Kushmurun deposits are part of the Ubagansk (brown-coal) Basin that belongs to the Turgay lowlands. The deposit is in the Kustanaysk Oblast' of the Kazakh' S. S. R. Its northern boundary meets the Kartaly-Akmolinsk Railroad.

The coal-bearing measures are overlain by 25 to 110 meters of water-bearing sands and clays. Twenty-one seams of brown coal of workable thickness have been found at the deposit. The most significant are those designated as Verkhny Moshchny and Nizhny Moshchny. The total thickness of these 2 seams measures 23 to 25 meters. The average ash content of the coal does not exceed 15 to 20 percent; moisture content, on a useful calorific basis, varies from 26 to 36 percent. The useful calorific value of the coal is about 3,000 kilocalories per kilogram. The deposit has enough reserves to develop an annual capacity of 15 to 20 million tons.

Five large-scale strip mines are planned for this area in the Sixth Five-Year Plan.

The Kushmurun coals are intended principally for use in thermal-power stations of the Urals and Kazakhstan.

The Orsk brown-coal area is in the Aktyubinsk Oblast' of the Kazakh' S. S. R. Ten seams of brown coal were found within the Orsk area; 2 of them had a thickness of 1 to 2 and 9.8 meters each. The coal seams are in the southern part of the deposit at a depth of 8 to 20 meters and elsewhere at a depth of 100 to 150 meters.

The coal is a lignite with an ash content of 10 to 30 percent. The useful calorific value is up to 3,000 kilocalories per kilogram. The mining-geological conditions are generally favorable. Many of the deposits can be worked by small vertical-shaft mining.

Southern-Ural Brown-Coal Basin

This basin is in the Chkalov Oblast' of the Bashkir A. S. S. R.

The coal-bearing measures are deposited in small, separate deposits having lenticular deposits of earthy-brown coal, 20 to 30 meters thick.

The coal seams are flat, and most of the deposits of the basin can be strip-mined. The overburden is 20 to 80 meters thick.

The ash content of the coal is 12 to 25 percent, and its useful calorific value, about 2,000 kilocalories per kilogram.

Two strip mines are operating in the area; two additional large-scale strip mines are planned for this area under the Sixth Five-Year Plan. Some of the coal is used in briquets, and some in electric powerplants.

Kansko-Achinsk Basin

The Kansko-Achinsk Basin extends in a wide zone for more than 700 kilometers along the Trans-Siberian Railroad. The basin falls in Krasnoyarsky Kray, and part of it extends into the eastern part of Kemerovo Oblast'.

Coal-bearing strata show 30 seams almost horizontal at a depth not exceeding 200 meters. The basin at places contains a thick coal seam (14 to 130 meters) at depths of 30 to 50 meters.

The Kansko-Achinsk Basin has largely brown coals, except for the Sayano-Partizansk deposits, which has bituminous coal. The brown coals are good for thermal-power generation. They have a useful calorific value of about 3,000 kilocalories per kilogram and contain 12 to 15 percent ash.

In measured reserves the deposit ranks as one of the highest in the U. S. S. R. Mining conditions over the main part of the basin are favorable for strip mining, and the low production costs make Kansko-Achinsk coal the cheapest fuel in the U. S. S. R. The Borodinsk, Nazarov, Bogotol', and Itat' are the large deposits of the basin. The Borodinsk and Nazarov deposits are being developed at present, basically, by strip mining.

The Itat' and Bogotol' deposits represent an exceptionally large reserve for future development of the coal industry.

Both deposits are directly on the Trans-Siberian Railroad on the border of the Kemerovo Oblast' and Krasnoyarsk Kray. The Itat' seam or the upper coal seam (35 to 65 meters thick) is of the greatest interest. The seam pitch varies between 2° to 3° and 10° to 15°. In both deposits the seam extends 80 kilometers. The average ratio of overburden to coal for the Itat' deposit is 1.2 cubic meters to 1 ton and for the Bogotol' deposit, 1 to 3 cubic meters to 2 tons. The reserves of coal that are suitable for strip mining are estimated at several billion tons. Because of the low fuel requirements in the neighboring areas, the Kansko-Achinsk Basin has not been greatly developed. With the large-scale industrial development of the Kemerovo Oblast' and the Krasnoyarsk Kray in the Sixth Five-Year Plan, the opening of strip mines with an annual capacity of 6-to 9-million tons is planned at the Nazarov, Borodinsk, Itat', and Bogotol' deposits.

The Tungusk, Yakutsk, and Lena coal regions and other deposits of the northern regions of Siberia and the Far East represent an unlimited reserve for further development of the coal industry of the U. S. S. R. At present the deposits of most interest are those of the South Yakutsk (Aldansk) Basin and those of the Tungusk coal region in areas near the Angar River where the Bratsk hydropower center and other industrial plants are being constructed.

Within the South Yakutsk Basin, about 400 kilometers from the Siberian Railroad, are large reserves of high-quality coking coals that can serve as a base for the development of a metallurtical industry in the Far East.

In the southern portion of the Tungusk coal-bearing area are large bituminous-coal deposits suitable for strip mining.

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